

CLAIMS

What is claimed is:

- 1 1. An apparatus comprising:
2 a hybrid network having a hybrid input, a receive input, and a hybrid
3 output, wherein the receive input is capacitively coupled to a subscriber line
4 carrying an upstream data signal and a downstream data signal;
5 a driver providing the upstream data signal to the subscriber line and
6 the hybrid input, wherein the driver is capacitively coupled to the hybrid
7 input, wherein the hybrid output provides the extracted downstream data
8 signal from the subscriber line.
- 1 2. The apparatus of claim 1 wherein the hybrid network resides on an
2 integrated circuit die.
- 1 3. The apparatus of claim 2 wherein the driver resides on the same
2 integrated circuit die.
- 1 4. The apparatus of claim 1 wherein the hybrid network is a
2 complementary metal oxide semiconductor integrated circuit.
- 1 5. The apparatus of claim 1 wherein the upstream and downstream data
2 signals are multitone modulated data signals.

1 6. An apparatus, comprising:

2 a hybrid network coupled to receive an upstream data signal and a
3 downstream data signal communicated on a subscriber line, the hybrid
4 network extracting the downstream data signal, wherein the hybrid network
5 order is less than or equal to 2.

1 7. The apparatus of claim 6 wherein the hybrid network further
2 comprises:

3 a receive port coupled to receive a composite signal including the
4 upstream and downstream data signals from the subscriber line and the
5 upstream data signal from a driver, wherein a transfer function from the
6 driver to the receive port is $\frac{Z(s)}{R_D + Z(s)}$, wherein R_D is a driver output
7 impedance wherein $Z(s)$ is a subscriber line impedance;

8 an output port providing the extracted downstream data signal,
9 wherein a transfer function from the receive port to the output port is
10 $K_{rx} \cdot \frac{s}{s + HYB0}$, wherein HYB0 is programmatically adjustable, wherein K_{rx} is a
11 receive path gain.

1 8. The apparatus of claim 7 wherein the hybrid network further
2 comprises:

3 a hybrid input port coupled to receive the upstream data signal from
4 the driver, wherein a transfer function from hybrid input port to the hybrid
5 output port is $K_{HYB} \cdot \frac{s}{s + HYBP}$, wherein HYBP is programmatically adjustable,
6 wherein K_{HYB} is a hybrid path gain.

1 9. The apparatus of claim 8 wherein the subscriber line impedance is
2 approximated by series coupled resistor R_x and capacitor C_x , wherein the
3 transfer function from the driver to the receive port to the output is
4 $K_{rx} \cdot \frac{1 + sC_x R_x}{1 + sC_x (R_x + 2R_D)} \cdot \frac{s}{s + HYB0}$, wherein HYB0 is adjusted to have a value
5 substantially equivalent to $\frac{1}{R_x C_x}$, wherein
6 wherein HYB0 is adjusted to substantially match $Z(s)$, wherein HYBP and
7 KHYB are selected such that $K_{HYB} \cdot \frac{s}{s + HYBP}$ is substantially the same
8 as $K_{rx} \cdot \frac{1 + sC_x R_x}{1 + sC_x (R_x + 2R_D)} \cdot \frac{s}{s + HYB0}$.

1 10. The apparatus of claim 6 wherein the hybrid network is tuned to
2 behave substantially as a first order network.

1 11. The apparatus of claim 6 wherein the hybrid network resides on an
2 integrated circuit die.

1 12. The apparatus of claim 11 wherein the hybrid network is a
2 complementary metal oxide semiconductor integrated circuit.

1 13. The apparatus of claim 6 wherein the upstream and downstream data
2 signals are multitone modulated data signals.